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Modeling the micro-dynamic environment of tissue scaffolds via representative volume and full domain Lattice-Boltzmann Method simulations FEMI KADRI, New Jersey Institute of Technology, CORTES WILLIAMS, VASSILIS SIKAVITSAS, University of Oklahoma, ROMAN VORONOV, New Jersey Institute of Technology — In tissue engineering, stresses generated by culture media flow through scaffolds play an important role in stimulating cell/tissue growth. Unfortunately, scaffolds have complex internal structures which make experimental stress calculation difficult. Rather, computational models based on scaffold geometries are utilized. However, simulating these models is also computationally-expensive. Therefore, approximations based on smaller representative volumes (RV) obtained from full scaffolds are often used. Although this approach saves computation time and bypasses the inherent complexity of simulating large domains, simulation outcomes can be very different from full geometry simulations due to smaller domain and inconsistent use of boundary conditions implemented by both approaches. Since there is no established guide or reference for estimating the error associated with the RV approximation, this study attempts to fill that void. To achieve this, Lattice-Boltzmann method is used to simulate fluid flow through 3D reconstructions of CT scaffold images for both RV and full scaffolds. Wall shear stress estimates obtained in both cases are compared for scaffolds of varying pore sizes and porosities. Results show that while both approaches generate significantly different flow fields and localized shear stresses, mean shear stresses estimates are of same magnitude.

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